2015

Analyzing charges and payments received for discharged patients at teaching hospitals in relation to patient satisfaction and overall Medicare charges

Rob Sutter
University of Kentucky, robsutter@uky.edu

Martin School of Public Policy and Administration

Analyzing charges and payments received for discharged patients at teaching hospitals in relation to patient satisfaction and overall Medicare charges

Rob Sutter

Spring 2015

Executive Statement

The affordability of healthcare is a major, recurring topic in the media. One of President Obama's cornerstone policies has been the attempt to make health care affordable. Part of the concern lies in cost differences for similar procedures. The cost for a standardized procedure such as abnormal cardiac dysrhythmia without complication varies greatly between hospitals. The cost difference of a patient getting treated for such an event can be an average of $30,000 depending on which hospital you go to. There is no immediately apparent reason for such a large difference. Another noticeable item is that all the hospitals receive a different amount of money from the combined Medicare, Medicaid, and private insurance. Why is there not a standard, default payment system? Why do hospitals charge differently for the same admitting diagnoses, even though there is a standard of care that should mimic the same treatment for each patient? Does the hospital, "average Medicare charge per patient" influence the overall cost for a standard diagnosis? Does hospital patient satisfaction score explain it? In my Capstone, I am to address these questions.

By doing this capstone, I contribute to a broad trend in healthcare, usually referred to as healthcare analytics. It consists of the use of software and consulting services, extensive reliance on data, statistical and qualitative analysis, explanatory and predictive modeling (Shmueli et al, 2011). Medical science has used data for many years. The financial and business aspects of healthcare are only recently becoming more data-driven. The days of administrators consisting of physicians making the logistical and executive decisions have been quietly ending since the beginning of the 21st century. The people who are now making those decisions tend to have business or economic backgrounds and very little healthcare knowledge. However,

people with healthcare degrees who are getting business or administrative related degrees are also starting to take over these roles. It is no secret that the costs of providing care to patients have increased immensely in the last 15 years as cutting-edge technology that almost has no ceiling cost is provided to care for even sicker patients. Medicare has been getting squeezed through such policies as the Budget Control Act of 2011, while costs have ballooned due to the addition of "baby-boomers" who have started swelling the volume of people who qualify. When Medicare was first created in 1965, the budget was around $10 billion (about $74 billion in today's dollars), in 2013, the cost was $583 billion according to the Congressional Budget Office (CBO). The budget has more than doubled since 2000. Another wake-up call for hospital efficiency is the fact that Medicare payments to hospitals and providers were made public in 2013, showing the disparities in what hospitals charge on average for procedures and what they receive on average. All of this is beginning to induce hospitals to become more lean, business-like, and efficient in order in their provision of care to patients. A common saying about non-profits is, "no money, no mission," which unfortunately, has become reality for hospitals.

Literature Review

Rising healthcare costs have recently been a major policy issue. This is evident from the over 40 million Americans estimated to not have health insurance prior to the passage of the Patient Protection and Affordable Care Act (hereafter referred to as the Affordable Care Act. These Americans either do not have jobs that provide health insurance, cannot afford health insurance on their own, or do not qualify for Medicaid. Many people believe that for a business that is designed to help people, leaving such a large population unable to afford healthcare is

unacceptable. Millions of Americans are faced with the costs of receiving life-saving treatment which can amount to tens to hundreds of thousands of dollars that they owe afterward. Also, many Americans are unable to take advantage of life-saving cancer treatments or pharmaceuticals due to the high-cost. How is it that a country where some of the best medical care is available, we cannot afford to take care of its population?

According to the Organization for Economic Co-operation and Development (OECD), the United States spends $8,745 per capita on healthcare (OECD, 2012). This comes out to 16.9% of the overall GDP, the highest among OECD countries. Despite all this spending, the United States has the 8th lowest life expectancy and one of the highest rates for obesity (28.6%) in the OECD group. While there are many different components in the costs of healthcare, hospitals account for 33.4% of the healthcare costs in the United States (Lancet, 2014). Not only is healthcare expensive, but multiple studies are also showing it to be extremely inefficient (Berwick et al, 2012). This inefficiency has afflicted both the private and public healthcare market. Fortunately, now more information is available to inform the debate: The Centers for Medicare/Medicaid Services (CMS) have made data on hospital charges and payments received public information. I will be reviewing research and news topics that are relevant to my capstone.

The Invisible Hand Guiding the Healthcare Market?

McKinsey & Company, an economic consulting group, have advisers looking into the economics of healthcare. One of their published articles discovered that competition is better when care is less specialized (Dash et al 2010). In a highly specialized setting, for example,

pediatric oncology, where there is an enormous cost-of-entry barrier because of the highly specialized skills it takes to run such a center, it would be inefficient to have competition. However, for an outpatient clinic similar to an urgent treatment center, the barrier to entry is much smaller. This makes competition a good thing, because a large choice of providers has brought the costs of a clinic visit down (Dash et al 2010). This is evident in the growing number of ambulatory centers that have gone into business. The average retail clinic, where there is one clinic for every 10,000 people, visit for routine or minor care costs on average, $76. The same visit at a hospital emergency room (one Emergency Department per 100,000 people) would cost $499 on average (PwC, 2014). One major outcome is the affordability of using mid-level practitioners to run routine clinics that are affordable to the point that insurance is rarely needed because the costs tend to be less than the co-pay (Roblin et al, 2004).

Waste of money and resources has also plagued the American healthcare system. There are disturbing claims that nearly 20% of the money spent on healthcare is wasted through six different categories (Berwick et al, 2012). The categories are: 1) Failures of care of delivery; 2) Failures of care coordination; 3) Overtreatment; 4) Pricing failures; 5) Administrative complexity; 6) Fraud and abuse. Like many of the other themes of the literature, the business model of healthcare is not special unto itself. The authors, Dr. Berwick and Dr. Hackbarth, built on the work of Pacala and Socolow, who created a strategy of reducing CO_2 emission through a "wedges" model. The wedges model frames two different trajectories of Co_2 levels over time. The first is, "business as usual" trajectory and the second, uses a "wedge" of 15 other tactics

(solar panels, better insulation, etc.)[1] to bring carbon reduction down over time. The same theory is used with the six categories, with one trajectory, the "business as usual model," and the other trajectory, their interventions. Scientists, who study the atmosphere and claim that global CO_2 emissions are unsustainable on the current trajectory, are now joined in a similar argument with healthcare spending on its current trajectory. The authors apply the same concept to health care to provide a low estimated $2.2 trillion in savings to healthcare from 2012-2020. Resembling other business models, the challenge to reduce spending in healthcare is similar to other problems. Two relevant conclusions from this paper are: There is plenty of opportunity for savings in healthcare; and healthcare is not unique in its business practices.

How Medicare Works

I will be evaluating what Medicare pays the hospital compared to what the hospital charges on average as my dependent variable. Not too long ago, Medicare paid hospitals on a "Fee-for-Service," (FFS) basis, but those days are gone as Medicare has tightened its budget. Now, in principle, Medicare pays a set rate for each diagnosis that a patient is discharged with. In practice, it is a little more complicated than that (Reinhardt, 2010). There is a uniform system that Medicare uses to pay the hospital each time that they are billed. This is important, because unlike private insurance, Medicare has to be completely transparent in how they pay hospitals. According to the article, one of the variables that Medicare uses is "geographical, wage-adjusted hospital cost." In my statistical calculation of what hospitals receive, one of my variables will include cost-of-living. Without such a control, hospitals in regions with a notoriously high cost-of-living (such as Manhattan or San Francisco), would look like they

[1] See appendix for full list

receive the most money. There are actually six different variables to adjust Medicare payments upward or downward from the "base diagnosis cost." These six variables are: diagnosis, geographical wage, complication, average capital costs, disproportionate share (the average amount of uninsured that visit the hospital and supplies).

A new punitive measure is also starting to change the way that hospitals are reimbursed by Medicare. Medicare is now penalizing hospitals for being negligent and ultimately inefficient (Rau, 2014). For example, a young, healthy patient comes in with abdominal pain and ends up getting their appendix removed, a very routine, low-risk procedure. While the patient is staying their one night in the hospital, they fall on their way to the bathroom and break their arm. The fall is considered to result from "negligence" on part of the hospital. Aside from what the patient may decide to do litigiously, Medicare will no longer pay for any of the costs associated with the care of the broken arm. Anything that draws a red flag as unassociated with the patient's primary stay, such as a bedsore acquired during admission, gets reviewed by medical personnel who work for Medicare's financial department. Therefore, there is starting to be larger gap in what the hospital bills versus what the hospital receives from Medicare. Furthermore, any re-admission in the 30 days after discharge is also flagged. If the patient comes back to the emergency department a week after their appendix is removed (with redness around the wound and a high fever), then Medicare will not pay a dime for any of the treatment associated with the septic patient, even though it is a separate diagnosis. While the article talks about the hardship and changes that academic medical centers have to make, it carries vital references direct from Medicare, which make the billing process less technical and

easier to understand. This will be the evidence that I need to make my correlation between hospitals that overbill also being inefficient within one another less anecdotal.

In addition to not paying any additional costs associated with preventable or negligent care, Medicare is also issuing fines for hospitals that underperform (Rau, 2014). The article provided data on every hospital that bills Medicare and posts their scores according to three different criteria: Central-line associated bloodstream infections, catheter-associated urinary tract infections, serious complications (based on eight types of injuries, including blood clots, bed sores and falls). It listed whether or not they were penalized by Medicare as well. Most of the hospitals hardest hit were teaching based hospitals. The fines range from 1-3% and come out as a proportion of every Medicare payment. This fine becomes active for one calendar year and is reviewed every September.

Big Data[2] in Healthcare

Consumers have been clamoring for more transparency in healthcare billing for many years. Patient claims including being charged $40 for an aspirin or $3500 for a 30 minute MRI have been fodder for media outlets for years. However, at the same time, nothing had changed in hospital billing transparency. As the supply of information is moving everything in healthcare to electronic records, it has indirectly provided a treasure trove a data that has helped standardize information from pharmaceuticals, patient care, and billing practices. Physicians are relying more on evidence-based-practice (EBP) (Kayyali et al, 2013). The author points out some reasons that healthcare has lagged behind other institutions such as banking or retail

[2] Big Data refers to "extremely large data sets that may be analyzed computationally to reveal patterns, trends, and associations, especially relating to human behavior and interactions"

when it comes to big data. One of the major concerns is the breach of patient privacy, a hallowed right, that was put into a law named Health Insurance Portability and Accountability Act (HIPPA) at the dawn of the internet age.

The arrival of big data in the opaque world of healthcare billing has become a boon to activist consumers and a wake-up call to the hospitals, according to an article in the NY Times that was published less than a week after CMS made hospital billing data public. The authors, Barry Meir, Jo McGinty, and Julie Creswell, did a few small comparison studies of hospitals in the same region on the average costs of certain procedures. Although their data was "cherry picked" and contained extreme examples that are not a probability sample of the nation as a whole, it still raised some very interesting questions to follow. The article also referenced several hospital administrators who were unaware when exactly CMS was going to release the billing data. This shows that the initial data released in 2014, is an unbiased snapshot of the billing practices for hospitals as they were unable to manipulate the numbers in their favor.

One system that is going forward with a high level of transparency in healthcare is the National Health System (NHS) in England. Their experiment in posting all their hospital data online for the public is being closely watched by other countries with a public healthcare system. Letting the public scrutinize the full extent of data about hospitals, both good and bad, requires a large amount of political and professional courage. According to Henke et al (2011), even in the US, where health care data is abundant, political and commercial considerations have hindered attempts to use public reporting to drive outcome improvements. In the small areas where data and other report cards are public, it has helped drive outcomes upward. While some criticize that hospitals are "performing for a grade," the overall effects have been

mainly positive for both the patients and productivity. The Pennsylvania Health Care Cost Containment Council (PHC4) has published a Hospital Performance Report from 158 general acute care hospitals in the state of Pennsylvania since the late 1990s. This has made Pennsylvania one of the most efficient states for healthcare costs to patients in the US. In addition, the *US News & World Reports* annual Best Hospitals in the US issue is widely purchased by consumers and discussed internationally. Hospitals proudly display any high ranking that they receive as a form of advertisement. It seems the demand for data has been there, but has not been supplied, until recently.

Shoemaker (2011), has touted the CMS data being made public, as a great starting point. By just getting to look at hospitals' complication rates, both the consumers can make informed decisions and hospitals administrators are aware that their hospitals are on display. More importantly, it allows other data analysts to see trends that may affect outcomes like re-admission rates being linked to nursing home-to-hospital admissions for example.

Summary of Literature

The CMS releasing hospital data is an important and exciting step for improving both healthcare quality and efficiency. Big data in healthcare is still in its infancy which is why there are only a few published journal articles, but many media articles, showing that there is a lot of speculation, but not a lot of evidence. By looking at what hospitals charge and how they rank against each other, I will be opening the door to see any correlation between over-charging and low-quality of care. This would attempt to prove or debunk the case of "pricier does not always mean better." This does not mean that proven, poor quality hospitals should shut down, but

rather they may become the biggest improvers. After all, the data that made their problems so public can also be the same data that provides them with the tools to fix their issues. This provides the hospitals with a little competition that will ultimately be positive for the patient.

Research Design

My data cover the hospitals that are part of the University Healthcare Consortium (UHC) network (UHC, 2014). This is a network of academic medical centers that have pooled their resources to become more efficient through sharing ideas and data. UHC hospitals all have to be non-profit hospitals that are affiliated or integrated with an academic medical center. In order to be affiliated or qualify as an academic medical center, a hospital must support graduate medical education, employ clinical faculty, and sponsor or participate in a minimum of ten graduate medical education programs or have 75 residents, with an intern/resident to bed ratio of at least 0.10. Focusing on UHC hospitals eliminates any extreme outliers in costs for standardized procedures due to sub-standard performance (UHC, 2014). In addition to being a UHC member, hospitals that I include in my data also have to have charge/payments received data on the Center for Medicaid/Medicare Services (CMS) for Medicare Diagnosis Related Group (DRG) 310, Cardiac Dysrhythmia & Conduction Disorders w/o MCC/CC (major complications/co-morbidities). There would be two main reasons for a UHC member hospital to not have data for DRG 310. The first reason would be not enough data for the hospital to average and send to the CMS database. The second reason would be that there is another, nearby hospital that is not a UHC member, specializing in cardiac patients. Applying my selection criteria, my final sample consists of 273 hospitals from nearly every state.

The reason I chose DRG 310 is because the treatment is so universal and standardized. According to the American Heart Association, a cardiac dysrhythmia is anytime that the heart is beating below 60 beats per minute (bpm) (bradycardia), and anytime the heart is beating over 100 bpm (tachycardia) (AHA, 2015). There is a uniform standard of care to treat anyone who shows up to the hospital with either bradycardia or tachycardia (Zipes et al, 2006). The data is from hospitals that discharged these patients and billed them under DRG 310, which rules out any other cause (i.e. anxiety, syncope). It also rules out any terminal or complicated patients that could have affected the average charges by staying in an Intensive Care Unit (ICU) or involving an extremely expensive procedure (i.e. cardiac stent, pacemaker, heart mate).

My dependent variable is a ratio of what Medicare reimbursed versus what the hospital charged for DRG 310. I express this ratio as a percentage, where 100 would indicate Medicare reimbursing the full amount of the claim. The reimbursement includes any Medicare Part A and Part B payments made for services provided to a patient during an episode of care, which includes the 3 days prior to the hospital stay, during the stay, and during the 30 days after discharge from the hospital (Medicare, 2015). The charges from the hospital are the provider's average charge for services covered by Medicare for all discharges in the DRG (CMS, 2014).

My first independent variable is the "Spending per Hospital Patient with Medicare" (Medicare Spending per Beneficiary) average. This measure shows whether Medicare spends more, less, or about the same on an episode of care for a Medicare patient treated in a specific hospital compared to how much Medicare spends on an episode of care across all hospitals nationally. (Medicare, 2015). This includes average payments for all services provided, not just for DRG 310. This data is based on a percentage with 1.00 multiplied by 100 being the average.

Any number below 100 means that Medicare spends less than the national average and any number above 100 means that Medicare spends more than average.

My second independent variable is patient satisfaction. This adds a customer-service perspective to the hospitals and compares them much like other businesses are compared on customer satisfaction levels. Good quality and prices do not do a business well if they cannot convince their customers that they care.

Data Collection

My data was collected from a variety of sources. The UHC hospital list was collected from a list of members on their website. In order to correlate the proper DRG codes with the hospitals on the DRC list, I went by hospital number. Every hospital in the United States is given a five digit "Provider ID" code to help identify them. I performed a search on the Center for Medicare and Medicaid Service (CMS) website for every hospital on the UHC list and found the five digit Provider ID code for each one. To collect the data on the Hospital Related Charges and the Average Medicare Payments, I went to the government database for CMS and collected the data that they had on each hospital that was in the UHC network. This data was from the fiscal year for 2011, which for the vast majority of hospitals would have been July 1, 2010-June 30, 2011. Not every hospital that was listed on the UHC network was on the CMS data set for DRG 310. This was due to a few factors. One factor would be that the UHC facility was not designed for treating that particular diagnosis, for example, the facility would be a neurological-only specialty center or a psychiatry ward. Another reason would be that the UHC-affiliated center would be close to a non-UHC center that specialized in cardiac-related diagnosis and

that, therefore admitted the majority of the DRG-related patients. This and other factors would lead a UHC hospital to have less than ten discharges a month with DRG 310. The final reason that a UHC hospital would not make the CMS data list was other related data errors or problems that would potentially cause the hospital to become a major outlier. Out of the over 450 hospitals in the UHC network, only 274 made the original data list for my model.

Once I had the list of qualifying UHC hospitals with the correct DRG, I went to Medicare's website for comparing hospitals. From that website, I was able to collect data on two of my independent variables. In turn, Medicare collects the data from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS). The purpose of HCAHPS is "to provide a standardized survey instrument and data collection methodology for measuring patients' perspectives on hospital care" (HCAHPS, 2015). I was able to collect the data for average Medicare spending for all DRGs and patient satisfaction score. For average Medicare spending, I collected the data from the list "Medicare hospital spending per patient (Medicare spending per beneficiary) (displayed in ratio)." There were several different scores for patient satisfaction based on different degrees of quality of care. The one score that I felt was the best representation of overall patient satisfaction was, "Percentage of patients that gave their hospital a rating of 9 or 10 on a scale from 0 (lowest) to 10 (highest)." Unfortunately, my total number of qualifying hospitals for my data regression model was lowered by 17 due to data that was either missing or N/A for some hospitals. Also, four hospitals had "discrepancies in the data collection process," but not bad enough to be excluded from the data set per the HCAHPS Project Team. The only allowable exception for "discrepancies in data collection process" is under the category of "disproportionate stratified random sampling." This discrepancy gets

reviewed by the project team for any major bias or potential impact and the data is either allowed or listed as "N/A." This data was last updated December 18, 2014 and was collected in February of 2015.

Draft of Models

For my research design, I have one dependent variable and two independent variables.

Dependent Variable: Medicare payments received/Medicare charged by hospital as a percentage.

Independent Variables: (1) Patient Satisfaction Score (PSS)

(2) Average Medicare Charges (AMC)

Model

Medicare payments ÷ Medicare charges (as a decimal percentage) = constant term +b1* PSS + b2* AMC + random error

Medicare charges, are what the hospital bills for the care of a patient under DRG 310 (Cardiac Dysrhythmia without complications or co-morbidities) to Medicare. These charges vary due to a number of factors including overhead, supplies used, and staffing to name a few. As stated earlier, there are standing orders created by the American Heart Association (AHA) that create a uniform standard of care for a patient when they arrive at the hospital with symptoms that are consistent with a cardiac dysrhythmia. These include chest pain, heart rate above 100 or below 60, abnormal ECG (as primary diagnosis). A hospital that is running efficiently should be within the average or below what hospitals bill Medicare for this common

diagnosis. Therefore, hospitals that over utilize supplies, over-pay staff, over test, or spend too much on capital will bill Medicare in an effort to collect those costs. In the past, Medicare would make payments based off the billing as a percentage. The percentage of what was billed was, fee-for-service (FFS), giving incentive for doctors to perform more tests. Recently, Medicare has moved to payment as a fixed-cost FFS in addition to pay-for-performance (Berenson and Rich, 2010).

In the Research Design, I stated the six categories that Medicare uses to pay hospitals when they are billed. In the model that Medicare uses to pay, cost-of-living is included. Since cost-of-living is included, I do not need to include that multiplier on that side of the equation. In addition, a variable that is not included in the normal Medicare payment model, but is multiplied at the end of their model, is the fine penalty. In the literature review, it was stated that hospitals can be fined anywhere from 0-3% on every payment for not meeting quality standards. A hospital that is getting fined for this runs along the same category as when a private business is fined by another government agency for cutting corners. A hospital cannot just be efficient, but has to be a good steward on the things that they can prevent.

By dividing what is paid to the hospital over what was billed, I am capturing a percentage that reflects the efficiency. A higher percentage shows a higher efficiency. This is related to lower billing costs by the hospital as it has already by shown in several papers that there is no longer a correlation between billing and what is paid by Medicare. Therefore, the data that shows what a hospital charges, is either a reflection on what it costs for them to perform the duties to a patient, or displays an impractical profit margin for the discharge of DRG 310.

Patient satisfaction is a good independent variable to predict the dependent variable. My hypothesis is that a high satisfaction relates to efficient care. An example of this, Medicare fines that affect 0-3% of each payment for hospitals due to hospital acquired infections, as stated in the literature review. Poor patient care leading to central-line or urinary catheter infections is a predictor of poor patient satisfaction. Patients and the public are now educated about preventable infections and when an issue arises with your care in the hospital that could have been prevented, it will negatively affect their satisfaction. Also, hospitals that bill honestly and realistically are perhaps also well-run in ways, for example, customer service, that make patients more satisfied.

My second independent variable is the average Medicare charges for all DRGs for each hospital in the captured data. This data is in the form of a percentage comparing it to the rest of the hospitals with what they charge Medicare on average. The lowest is 79 and the highest is 116, the average is 100.

Findings

In order to see if there was any relation between my variables and the data, I used a method of analysis called regression. However, before I did a regression analysis, I wanted to make sure that the data was not skewed in any way of outliers or to make sure a certain hospital in the data set was not being over or under represented on a large scale. I therefore looked at the average number of discharges within each hospital. While this data was not a variable on my regression model, each discharge was an observation within the hospital. The average number of discharges for each hospital within the data set as DRG code 310 per month

was 52. The minimum number was 11 and the maximum was 224. The standard deviation was 42 showing that the majority of the numbers were clustered in a fairly wide range from the minimum to about 94.

I also reviewed the distribution of the dependent variable (percentage of average Medicare payments over average covered charges), looking at mean, standard deviation, and minimum/maximum. The variation of charges between the hospitals was very large. There was a variation from the lowest average to the highest of nearly $50,000 in charges. The average charge was $14,664 with a standard deviation of $8,128. It does put in perspective though that the average charge is over $14,000 for a patient who shows up to a university hospital with a minor cardiac dysrhythmia. The algorithm that Medicare uses appears to be quite consistent with their data. An average pay-out of $3,453 with a standard deviation of only $1,279 shows that there are very few outliers. It also shows that while a hospital can charge as much as $54,468 on average for a discharged patient under code DRG 310, they are only going to get a certain amount from Medicare based off what the algorithm, not what the hospital charged.

The independent variable of average Medicare charges per patient ratio varied anywhere between 79 at the lowest, meaning that a hospital charges 79% of the average for all patients to Medicare, and a high of 116, meaning that a hospital charges 116% of the average for all patients to Medicare. The average and the median were both at 100, meaning that the hospital charged data collected by Medicare is relevant to their ratio of 100 being the average. A standard deviation of about 5.5 showed that there was not a lot of variation between the numbers.

Patient satisfaction score was my other independent variable in the regression model. The scores were from 49% at the lowest to 90% at the highest mark. The average score was 71% with a variation of about 7%. All the data is listed below.

Table 1. Mean, Standard Deviation, Median, Minimum/Maximum

	Discharges	Avg Covered Charges	Avg Medicare Payments	Avg Medicare Charges per patient ratio	Pt Satisfaction Score %
Mean	52	$14,664	$3,453	99.54	71
Std Dev.	42	$8,128	$1,279	5.61	7
Median	38	$12,506	$3,101	100.00	72
Min	11	$4,769	$1,822	79.00	49
Max	224	$54,468	$7,452	116.00	90

I ran an ordinary linear-regression model in Excel and obtained the following results.

Regression model of

(Avg Medicare payments ÷ Avg Medicare charges (as a percentage) for DRG 310 procedures = Constant term + b1 *(Relative amount of Medicare charges per patient for all discharges as a ratio) + b2 (Percent of patients who are satisfied) + random error

Regression Statistics	
Observations	255
R Square	0.1289

	Coefficients	*P-value*
Intercept	130.06	<0.01
Medicare spending per patient	-0.67	<0.01
Satisfaction score	-0.50	<0.01

In my regression analysis, I had a total of 255 observations. The two independent variables explain that about 13 percent of the variation in the dependent variables. All of my P-values were below .05. The results of my hypothesis were analyzed in the coefficients. According to the coefficient, a one percent higher overall Medicare spending per patient was

associated with two thirds of a percentage point lower Medicare reimbursement for DRG 301. This finding supports overall more efficient hospitals are more realistic in their DRG 310 charges and therefore get a higher percentage of those reimbursed.

The other coefficient showed the relation to the Medicare money received/charged and patient satisfaction. A one percent higher patient satisfaction rating was associated with half a percentage point lower Medicare reimbursement for DRG 310. This means that every time the patient satisfaction score of "whether they would give the hospital a 9 or 10 rating on a scale of 0-10," goes up one percentage point, then the percentage of what a hospital receives/charges Medicare goes down 0.49%. This goes opposite of my hypothesis that the higher a patient satisfaction score, the higher the Medicare received/charge score would be. This may be due to the fact that hospitals overspend or overcharge in the goal of getting a higher patient satisfaction score.

Limitations

There were several limitations in this study. First of all, the selection criteria for allowing, only UHC hospitals and DRG 310 created a population of hospitals that only represented 41 states out of 50. Two other states were taken out of the population due to their hospitals not having data for either of the independent variables in the regression model. Also, some of the states had hospitals with higher representation that did not match their state's population. For example, California, a state with a population of 38.8 million people (US Census Bureau, 2014) was only represented by 10 hospitals out of the 255 in the data population. Illinois, a state with a population of 12.9 million (US Census Bureau, 2014) was

represented by 11 hospitals, mostly in the Chicago area. This brings up another limitation within the states, population representation. Many of the hospitals were bunched up in urban areas where universities are prevalent, which caused the rural areas to not be as represented as extensively.

Another limitation is with the diagnosis-related group (DRG) itself. While DRG 310 has a very standard treatment algorithm that is recommended by the American Heart Association (AHA), not every patient is treated by that algorithm every time. This is due to a number of factors that cannot be controlled in a study such as this one due to the unpredictability that comes with being seen at the hospital. In the data, the discharge diagnosis is grouped as 310, not the admitting diagnosis. This means that a patient could have presented with symptoms that were treated differently before it was discovered by the medical team that the patient was really having cardiac dysrhythmia without co-morbidities or complication and discharged with the code 310. For example, a patient could have had come into the hospital complaining of chest pain requiring a much more involved and serious work up before being ruled out for a myocardial infarction (heart attack) and given a less severe, cardiac dysrhythmia diagnosis. With thousands of potential codes to give a diagnosis and multiple medical teams, some physicians have certain codes that they use more than others. Sometimes, physicians or medical billers use the code that fits best rather than the correct code in an effort to streamline the process or to qualify for payment. As a UHC hospital, resident physicians, on the frontline of patient care are inexperienced as they go through their training. Even though they are supervised by qualified attending physicians, the possibility of human error is still much higher than at a smaller facility with only experienced physicians.

Another limitation is the timeline of the data itself. The Centers for Medicare and Medicaid Services (CMS) released the financial data of Medicare billing and payments received last year for the year 2011. Hospitals were not notified when the data would be released and were unable to prepare which gives an accurate snapshot of the billing scenario. Furthermore, there is only data for one year, which makes it difficult for a couple reasons. One reason is there is no way to trend the data with only one year's worth of numbers. The other reason, because it is only one year, there is no way to tell if a certain hospital was an outlier within their own data. A hospital could have been having their best or worst year with either of the dependent or independent variables.

Further Studies

As more data becomes available, there will be trends to examine. Hospitals that are more efficient can be studied in depth in other ways to see what they are doing correctly. A bottom-up study could be done to see if the results could be replicated on those hospitals that are successful in being efficient. This study showed that hospitals that are billing less for other things have a higher proportion of their Medicare payments received/billed than other hospitals. More studies would need to be done to prove a causal relationship between the two. For the other question about higher customer service causing hospitals to bill more for Medicare, the data so far is interesting. Again, more studies would need to be done to examine if there is causation to go with this claim. Patients who would rank their hospital a 9 or 10 on a scale of 0-10 are customers of hospitals that bill higher. It would be interesting to see if there are any hospitals in the data set that both score high in customer service and have a high Medicare received/billed percentage and evaluate their relationship between customer service

and billing. The results of those studies would show if some of the other hospitals may be spending too much money on customer service for things that are not needed.

Conclusion

Hospitals that bill responsibly in relation to what they receive from Medicare for DRG 310 tend to bill less for other things. This is good for both Medicare and for the patient who is "self-pay." This is evident by two different events. On one side, you have a government agency that pays based off an algorithm no matter what the hospital charges, and on the other side, you have the "self-pay" patient who has no option other than what the hospital charges. So it would be ideal for the patient who goes to a hospital that charges less for the same service. Especially since on the preliminary findings, patient satisfaction has a cost-raising impact on what the hospital charges. I feel that hospitals have gotten away with charging exorbitant fees for providing a much needed service. Based off the data I collected, hospitals received an average of 23.5% from Medicare of what they originally billed. They money they are receiving from Medicare is obviously sustainable for the hospital to keep running. Otherwise, the hospitals would not accept Medicare, which is within their right. Therefore, I believe that hospitals should reduce their charges to a more realistic number in the interest of the "self-pay" patient. Honestly, $500 to run an EKG is ridiculous, especially when it costs about $20-50 to run one realistically. If Medicare and private insurance would pay what was charged to them, then the whole system would be unsustainable due to astronomical premiums. This makes the very institution that was designed to care and heal, become predatory.

This is an exciting time with federal government and the availability of big data, especially now in healthcare. For all the political discussion about the Affordable Care Act, both good and bad, it has brought a need for less opaque billing methods in healthcare. With data on this scale being made public, other hospitals are able to compare and benchmark themselves with each other. Consumers are able to make more informed choices than ever before. America has long been the country with one of the highest spending per GDP on healthcare that also is one of the unhealthiest of the developed country in terms of obesity and life expectancy. Part of that reason has been no rationale or reason to disrupt the status quo of the hospitals' business practice. Federal and donor money had always been plentiful in the past generations. Other data such as life expectancy has shown that there needs to be more financial accountability in the field of healthcare. The United States spends the most of any OECD country, but is does not have the best rankings. Little by little, hospitals are starting to become more business-like so there is less excess waste. A good model when people's lives are on the line.

Apendix

Appendix 1. Table of wedge models used by Pacala and Socolow

Energy Efficiency and Conservation	Economy-wide carbon-intensity reduction (emissions/$GDP)	Increase reduction by additional 0.15% per year (e.g., increase U.S. goal of reduction of 1.96% per year to 2.11% per year)	Can be tuned by carbon policy
	1. Efficient vehicles	Increase fuel economy for 2 billion cars from 30 to 60 mpg	Car size, power
	2. Reduced use of vehicles	Decrease car travel for 2 billion 30-mpg cars from 10,000 to 5,000 miles per year	Urban design, mass transit, telecommuting
	3. Efficient buildings	Cut carbon emissions by one-fourth in buildings and appliances projected for 2054	Weak incentives
	4. Efficient baseload coal plants	Produce twice today's coal power output at 60% instead of 40% efficiency (compared with 32% today)	Advanced high-temperature materials
Fuel shift	5. Gas baseload power for coal baseload power	Replace 1400 GW 50%-efficient coal plants with gas plants (4 times the current production of gas-based power)	Competing demands for natural gas
CO_2 Capture and Storage (CCS)	6. Capture CO_2 at baseload power plant	Introduce CCS at 800 GW coal or 1600 GW natural gas (compared with 1060 GW coal in 1999)	Technology already in use for H_2 production
	7. Capture CO_2 at H_2 plant	Introduce CCS at plants producing 250 MtH_2/year from coal or 500 MtH_2/year from natural gas (compared with 40 MtH_2/year today from all sources)	H_2 safety, infrastructure
	8. Capture CO_2 at coal-to-synfuels plant	Introduce CCS at synfuels plants producing 30 million barrels per day from coal (200 times Sasol), if half of feedstock carbon is available for capture	Increased CO_2 emissions, if synfuels are produced *without* CCS
	Geological storage	Create 3500 Sleipners	Durable storage, successful permitting
Nuclear Fission	9. Nuclear power for coal power	Add 700 GW (twice the current capacity)	Nuclear proliferation, terrorism, waste
Renewable Electricity and Fuels	10. Wind power for coal power	Add 2 million 1-MW-peak windmills (50 times the current capacity) "occupying" $30x10^5$ ha, on land or off shore	Multiple uses of land because windmills are widely spaced
	11. PV power for coal power	Add 2000 GW-peak PV (700 times the current capacity) on $2x10^6$ ha	PV production cost
	12. Wind H_2 in fuel-cell car for gasoline in hybrid	Add 4 million 1-MW-peak windmills (100 times the current capacity)	H_2 safety, infrastructure
	13. Biomass fuel for fossil fuel	Add 100 times the current Brazil or U.S. ethanol production, with the use of 250 $x10^6$ ha (1/6 of world cropland)	Biodiversity, competing land use
Forests and Agricultural Soils	14. Reduced deforestation, plus reforestation, afforestation and new plantations.	Decrease tropical deforestation to zero instead of 0.5 GtC/year, and establish 300 Mha of new tree plantations (twice the current rate)	Land demands of agriculture, benefits to biodiversity from reduced deforestation
	15. Conservation tillage	Apply to all cropland (10 times the current usage)	Reversibility, verification

References

1) Center for Medicare and Medicaid Services (2014). *Inpatient Prospective Payment System Provider Summary for the Top 100 Diagnosis Related Groups.* Internet resource. Retrieved 12/20/14 from https://data.cms.gov/Medicare/Inpatient-Prospective-Payment-System-IPPS-Provider/97k6-zzx3

2) University Health Consortium Membership List (2014). Internet resource. Retrieved 12/27/14 from https://www.uhc.edu/docs/003675405_UHCMembershipList.pdf

3) University Health Consortium About Us (2015). Internet resource. Retrieved 1/14/15 from https://www.uhc.edu/about

4) Pennsylvania Health Care Cost Containment Council. List of DRG codes (2010). Internet resource. Retrieved 1/14/15 from http://www.phc4.org/dept/dc/docs/list35.pdf

5) American Heart Association. Symptoms, Diagnosis & Monitoring of Arrhythmia (2015). Internet resource. Retrieved 1/14/15 from http://www.heart.org/HEARTORG/Conditions/Arrhythmia/SymptomsDiagnosisMonitoringofArrhythmia/Symptoms-Diagnosis-Monitoring-of-Arrhythmia_UCM_002025_Article.jsp

6) Zipes DP, Camm A, Borggrefe M, et al. (2006) Guidelines for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death. *Journal of American College of Cardiology*. 2006; 48(5)247-346.

7) Massechusetts Institute of Technology. *Living Wage Calculator* (2014). Internet resource. Retrieved 12/27/14 from http://livingwage.mit.edu/

8) Center for Medicare and Medicaid Services. *Hospital Compare* (2014). Internet resource. Retrieved 1/3/15 from http://www.medicare.gov/hospitalcompare/search.html?AspxAutoDetectCookieSupport=1

9) Shmueli, G., Koppius, O. Predictive Analystics in Information Systems Research (2011). *Management Information Systems Quarterly*. 2011; 35(3) 553-72.

10) Rau, Jordan. Teaching hospitals hit hardest by Medicare fines for patient safety (2014). *Shots: Health News from NPR*. Internet resource. Retrieved 3/11/2015 from http://www.npr.org/blogs/health/2014/12/19/371862146/teaching-hospitals-hit-hardest-by-medicare-fines-for-patient-safety

11) Centers for Medicare & Medicaid Services (2014). Penalties for Hospital Acquired Infections. Internet resource. Retrieved 3/11/2015 from http://cdn.kaiserhealthnews.org/attachments/HACPenaltyChart.pdf

12) Berenson, R., Rich, E. (2010). U.S. Approaches to Physician Payment: The Deconstruction of Primary Care (201). *Journal of General Internal Medicine*. 2010; 25(6) 613-18.

13) Dash, P., Meredith, D. (2010) *When and how provider competition can improve health care delivery*. Internet Resource. Retrieved 01/11/2015 from http://www.mckinsey.com/insights/health_systems_and_services/when_and_how_provider_competition_can_improve_health_care_delivery

14) Roblin, D. W., Howard, D. H., Becker, E. R., Adams, K., E., & Roberts, M. H. (2004). Use of Mid-level Practitioners to Achieve Labor Cost Savings in the Primary Care Practice of an MCO. *Health Services Research*, 39(3), 607–26

15) Berwick, D., Hackbarth, A. (2012). Eliminating waste in US health care. *JAMA.* 2012; 307(14)1513-16

16) Reinhardt, Uwe. (2010). How Medicare Sets Hospital Prices: A Primer. *The New York Times*. November, 26, 2010.

17) Rau, Jordan. (2014). Medicare cuts payments to 721 hospitals with highest rates of infections, injuries. *Kaiser Health News.* December 18, 2014.

18) Kayyali, B., Knott, D., Van Kuiken S., (2013) *The big-data revolution in US health care: Accelerating value and innovation*. Internet Resource. Retrieved 01/08/2015 from http://www.mckinsey.com/insights/health_systems_and_services/the_big-data_revolution_in_us_health_care

19) Henke, N. (2011). Transparency- the most powerful driver of health care improvement. *Health International.* Internet Resource. Retrieved 01/28/2015 from https://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/Healthcare%20Systems%20and%20Services/Health%20International/Issue%2011%20new%20PDFs/HI11_64%20Transparency_noprint.ashx

20) Shoemaker, William (2011). Benchmarking boon: tapping publicly available data to improve performance. *Health Financial Management.* 2011; 65(6) 88-94

21) United States Census Bureau (2014). State Totals: Vintage 2014. Internet Resource. Retrieved from http://www.census.gov/popest/data/state/totals/2014/index.html

22) PricewaterhouseCoopers LLP (2014). Medical Cost Trend: Behind the Numbers 2014. Internet Resource. Retrieved 04/09/2015 from http://www.pwc.com/en_us/us/health-industries/behind-the-numbers/assets/medical-cost-trend-behind-the-numbers-2014.pdf

23) Hospital Consumer Assessment of Healthcare Providers and Systems. Background. (2015). Internet Resource. Retrieved 04/09/2015 from http://www.hcahpsonline.org